CSE3300 Computer Networks and Data Communications (Spring 2015)

Midterm Exam

Student Name: ___________

Student NetID: ___________

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Question 1: Internet architecture and protocol stack (20 points)

1.1: What is the Internet from a service view? (5 points)

1.2: What is a network protocol? Why it is important? (5 points)

1.3: What are the major sources of packet delay in Internet? (5 points)

1.4: Why a layered architecture is considered harmful? (5 points)
Question 2: Web caching (15 points)

Consider the following figure, for which there is an institutional network connected to the Internet. Suppose that the average object size is 900,000 bits, and that the average request rate from the institution’s browser to the origin servers is 1.5 objects per second. Also suppose that the amount of time it takes from when the router on the Internet side of the access link forwards an HTTP request until it receives the response is 4 seconds on average. Model the total average response time as the sum of the average Internet delay, the average access delay (that is the delay from the Internet router to the institution router), and the local network delay. The average access delay can be computed as: $D/(1-DR)$, where $D$ is the average time required to send an object over the access link, and $R$ is the arrival rate of the objects to the access link. We also assume the local network delay is negligible.

Suppose a cache is installed in the institutional LAN, and the hit rate is 0.4. Please find the total average response time (Explain your answer briefly).
Question 3: Electronic mail (15 points)

3.1: Please describe the working principle of the SMTP protocol. (5 points)

3.2: What are the differences between SMTP and HTTP? (5 points)

3.3: What are the differences between SMTP and mail access protocols? (5 points)
Question 4: Reliable data transfer protocols (25 points)

4.1: What are the assumptions on the channel for rdt 1.0, rdt 2.0, rdt 2.1 and rdt 3.0? What are the mechanisms applied in each of these protocols to achieve reliable data transfer? (15 points)

4.2: Draw the finite-state machine (FSM) for the receiver side of protocol 3.0. (10 points)
**Question 5: Pipelined protocols (25 points)**

5.1: Please describe the key principles of Go-back-N (GBN) and Selective Repeat (SR) protocols. (7 points)

5.2: Please describe the differences between the TCP reliable data transfer and the Go-back-N (GBN) protocol. (6 points)

Consider the GBN protocol with a sender window size of 4 and a sequence number range of 512. Suppose that at time \( t \), the next in-order packet that the receiver is expecting has a sequence number of \( k \). Assume that the medium does not reorder messages. Answer the following questions:

5.3: What are the possible sets of sequence numbers inside the sender’s window at time \( t \)? Justify your answer. (6 points)

5.4: What are all possible values of the ACK field in all possible messages currently propagating back to the sender at time \( t \)? Justify your answer. (6 points)